methods of determining and allowing for these errors. In view of our present knowledge we now see that in establishing new stations better methods of exposure should be adopted, and such as are in fact very different from those that have hitherto been considered allowable. We must closely imitate the conditions prevailing at the average surface of the ground, that is to say, in the order of preference the exposure would be: (1) the pit gage; (2) the protected or the shielded gage near the ground; (3) several protected or shielded gages distributed over a flat roof; (4) the shielded gage on posts considerably elevated above slanting roofs. Moreover, in no case should a single gage be relied upon, but in all cases at least two similar gages at very different heights should be observed. From the records of these two gages we can compute the catch of the normal pit gage by the formula previously given.

As this formula is also applicable to the ordinary, and in fact to any form of gage, we furthermore see that an approximate correction, needed to reduce valuable past records to the normal gage, may now be determined, if these old gages are still being recorded, by at once establishing near them two or more similar gages at considerably different heights; from the records of all these gages for the next few years we may determine, at least approximately, a correction applicable to the past years of historical records. Finally, we are warned against attempting to draw from past records conclusions that are finer than the data will justify.

METEOROLOGY BY THE LABORATORY METHOD.

The November number of Popular Astronomy contains the following admirable article on the teaching of astronomy, which applies equally well to meteorology and is to be commended to all teachers and students.

If by the laboratory method is meant such observation and investigation of selected phenomena pertaining to any subject as shall yield to the student an abundance of essential facts—if it mean that from the many such related facts reasonable explanations of these phenomena may be expected from the student who thinks simply and logically—if it be a manner of so presenting a subject through its phenomena to the mind of a student that he may reach out toward conclusions of a general nature, to the principles and laws which pertain to that subject, as a direct sequence of his own observations and thought processes—if these be the aims of laboratory methods of teaching, then astronomy [and meteorology] may be thus taught, and demands such manner of presentation to the students of our secondary schools.

It is far from our purpose to pose as an instructor in pedagogy, or to enter upon any psychological discussion whatsoever. Yet it were pardonable, surely, to restate as a cardinal principle of educational work that mental growth results only from mind activity rightly directed. As the highest and best of the physical being demands that every muscle have its exercise and development, so the mind in its every capacity is to be exercised.

One stage in the development of the science of education was content to have the student memorize the words of the text regardless of any full comprehension of the thought expressed therein. It was a great step in advance when mastery of the thought of the author was made of prime importance, and the expression of that thought in the words of the student himself was encouraged or required. There remained a single step further, and with many a teacher it has yet to be taken in the full round of the science work, the *requirement of original thought from the student* as well as original expression of thought. To require of students in our secondary schools in study of any science nothing further than mastery of the thought of an author as expressed in the text book is neither the most complete nor the most profitable mental activity.

Allowing that we have in books veritable storehouses of the riches of ages of human experience, thoughts that are profound, language that is grand, thought expressions to whose depths and to whose heights we may scarcely hope to attain, expressions that may tax to the uttermost our endeavors of a lifetime to rethink them, humble travelers as we are over well marked mental highways and byways—allowing all this, it is contended that the great mass of books put into the hands of our students are *not of this character*, and that the writers of modern text-books for secondary schools are few who seek to do other than to put before the student in the simplest, most elementary manner possible the facts of the subject treated. It is the facts themselves and the manner in which they are presented that is of prime importance. Any course in science that stops short of requiring original thinking by the student, thinking that is based upon facts that are leavened through and through with the results of personal observation and investigation must needs be comparatively barren of mental growth and vigor.

The logical result of such views is to regard the text-book in science as a reference book in simple compact form, furnishing what shall be needed to supplement the results of the student's own efforts in observation and thought—a reference book differing not a whit in purpose from the other reference books found in any well appointed laboratory save in its larger use and *that it is the students'* own.

Happily the day was soon past when the science student of our secondary schools was looked upon as a discoverer, as one who by his unaided efforts was to re-establish the laws, principles and theories of the subject he pursued and all this as a result of his own investigations. the story of Agassiz, his student and the fish, was made to teach preposterous lessons. In most of the sciences the limits of original investigation are well defined, the need and use of text and reference books well established in supplementing laboratory work. In astronomy [and meteorology], however, oldest of the sciences, science of the material universe, the student is too often expected to know nothing save what his author tells him, to cultivate no mental powers in its study save the taxing of an already over burdened memory; or, at most, his powers are taxed in making out what the author means in his text, and through the exercise of the imagination in picturing what the author describes as existing.

In any attempt to apply the laboratory method to the teaching of astronomy [and meteorology] there is the same necessity as in the other sciences that no time be wasted upon comparatively unimportant phenomena; that observation shall be so carefully directed as to readily acquire the desired facts; and that these results shall be so related as to make generalization possible. That there are difficulties in the way is true, but they may largely be included under these heads: (1) A failure on the part of many teachers to appreciate the fact that although many of the phenomena of astronomical [and meteorological] science require apparatus too expensive and too complicated to be available, and although many of the conclusions are reached through reasoning too abstract to be within the comprehension of the students to be instructed—there still is wide range for observation and inference fully within the comprehension of pupils of high school grade: (2) The text-books in astronomy [and meteorology], with but an exception or two, not only tell all the facts that the student can easily acquire for himself under direction as well as those beyond the range of his ability and opportunity, but, withal, their pages are crowded with ready made inferences from these facts, making it wholly unnecessary for the pupil to do any thinking himself beyond that involved in language interpretation. He may study astronomy and complete his course, but still has no more knowledge of the relation of his work to celestial phenomena than one who studies the bookkeeping of the high school instead of the actual business conditions it is supposed to exhibit. Science teaching in any grade of school work should surely not make memory and imagination a first consideration—observation and thinking a secondary matter.

When teachers of astronomy [and meteorology] shall be content no longer to instruct in this science upon a basis so radically different from that of the generally recognized laboratory sciences, and shall demand for laboratory reference text books that are filled with facts clearly and logically arranged, and having terse statements of the theories advanced therefrom, together with such descriptions and explanations as are beyond the ability of the average student for whom they are written, but which at the same time are free of all such matter as may properly be required of students as the result of their own observation and thinking—when teachers shall demand that guides and manuals for the study of astronomy [and meteorology] shall be furnished even as in physics and in chemistry, to the end that like principles of instruction and of laboratory procedure may be applied to all alike—then, and not till then, will publishers come to the relief of such teachers as already seek to secure in the teaching of astronomy [and meteorology] in secondary schools the fullness of its possibilities for mental development, even as with other sciences, in addition to its value otherwise so fully recognized.

THE RECURVING OF HURRICANE TRACKS IN THE NORTH ATLANTIC.

The Pilot Chart for November, published by the United States Hydrographic Office, gives a diagram showing the path followed by the centers of twenty-five tropical cyclonic storms in the North Atlantic Ocean during the ten years, 1890–99. Concerning these Mr. James Page, of that office, makes the following remarks:

Of these storms Nos. 2 and 9 each pursued a course trending between north and west, the former crossing Florida into the Gulf of Mexico, the latter disappearing over the mainland in the vicinity of Charleston. The course of Nos. 10 and 16 was in a northeasterly direction throughout, although it is probable that the complete history of these storms would show an earlier movement toward the northwest. The absence of observations, however, precludes in either case any attempt to represent this earlier portion of the track. No. 20 followed an almost due northerly course, keeping well under the coast, and No. 21, although the barometric depression accompanying the storm originated in the Gulf of Mexico, failed to attain full hurricane violence until reaching the position indicated.